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THE MAIN DETERMINANTS OF INFLATION IN SOUTH AFRICA: AN EMPIRICAL INVESTIGATION

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Abstract. *This study investigated the determinants of inflation in South Africa using quarterly data from 1970Q1 to 2015Q4. The study was motivated by recent trends in domestic inflation that has frequently been at the upper end of the target range of between 3% and 6%, and the need to guide inflation-related policy since 2008. These recent trends raised concerns regarding the effectiveness of the current monetary policy approach in responding to internal and external factors that are significant in determining domestic inflation. Using Error Correction Model (ECM) modelling techniques, empirical results revealed that inflation expectations, labour costs, government expenditure and import prices are positive determinants, while GDP and exchange rates are negative determinants of inflation. To achieve the macroeconomic policy objective of a stable and low inflation rate for South Africa, more emphasis should be placed on anchoring inflation expectations, which was found to be highly significant in determining inflation.*

Key words*: inflation, South Africa, Error Correction Model*

1. Introduction

Inflation remains a crucial macroeconomic problem in South Africa, and the country continues to face a number of challenges with respect to persistent and escalating inflation rates. Despite inflation declining since 1970, it has frequently been at the upper end or even above the target range of 3% to 6% since 2000. Following the introduction of inflation targeting in 2000, the average annual rate of inflation in South Africa was approximately 6% between 2000 and 2013.

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High and volatile inflation can be damaging not only to businesses and consumers, but to the economy as a whole. The social and economic consequences of inflation are diverse and difficult to measure accurately. Inflation causes instability and inefficiency in the economy as it has the potential of slowing down economic growth in the long run. While the country is faced with other macroeconomic problems such as high unemployment and inequality, Marcus (2012) indicates that a high and volatile inflation rate increases uncertainty about future relative prices and also reduces the competitiveness of a country's exports.

The costs of inflation to the economy are linked to higher inflation volatility because the more unstable the rate of inflation, the less it is anticipated and the greater the risk of uncertainty. Inflation is determined by various factors, either internally, whereby policy makers have some degree of control, or by external factors that policy makers have no direct control over. Inflation can be defined as a sustained increase in the average price level, or alternatively, a continuous fall in the value of money (Mohr & Fourie, 2009). In South Africa inflation is measured by the Consumer Price Index (CPI) compiled and released by Statistics South Africa (Stats SA)*.

Various economists and policy makers have different views on whether inflation occurs as a consequence of demand-side factors (an increase in economic activities) or supply-side factors (increase in the cost of production). This view is also supported by Mankiw (2012), who stated that inflation can arise as a result of an increase in aggregate demand (demand pull inflation), and a decrease in aggregate supply (cost push inflation). Other inflation factors identified by Mankiw (2012) include monetary factors (increase in money supply) and structural factors (degree of independence of the monetary authorities). Furthermore, Friedman and Schwartz (1963) stated that "inflation is always and everywhere a monetary phenomenon", suggesting growth in the quantity of money relative to output as the primary determinant of inflation.

There have been numerous studies on the determinants of inflation in South Africa, most of which were undertaken prior to 2000. This period symbolises a shift in the political and economic structure in South Africa and also the shift with regard to the operations of the South African Reserve Bank (SARB). Previous studies focused more on monetary and structural determinants of inflation, taking into account the impact of changes in monetary policy frameworks, economic sanctions and political turmoil of the previous government. In 1986, a system of 'money supply target' was introduced; in 1989, that monetary system was enhanced in order to take a more consistent anti-inflationary policy stance, through an eclectic monetary policy approach, which was implemented in the 1990s.

The eclectic monetary policy used growth in money supply and bank credit extension as intermediate guidelines for the determination of short-term interest rates (Mboweni, 2004). In 2000, the SARB officially adopted an inflation-targeting policy

* Other measures of inflation include *inter alia,* producer price index (PPI) and GDP deflator (Mohr & Fourie, 2008, p. 478)

framework. Finally, the study intends to investigate the determinants of inflation with the aim of evaluating the effectiveness of anti-inflationary policy and to provide recommendations based on the results obtained from the model, with a view that the recommendations would assist policy makers in achieving the desired long-term inflation target of 3% – 6% in South Africa.

This study is structured in six sections. After this introduction, Section 2 presents an overview of inflation in South Africa, and Section 3 presents the review of literature on the determinants of inflation. Section 4 outlines the methodology and quantitative data to be employed in the study, while Section 5 covers data analysis and the discussion of empirical results. Finally, Section 6 concludes the study, highlighting major findings and policy implications.

2. Overview of inflation in South Africa

South Africa is an integral part of the global economy, and it is imperative to understand its competitiveness relative to that of its main trading partners by focusing primarily on the trends of inflation for the respective countries. Since the adoption of an inflation-targeting framework in 2000, the SARB has been able to maintain inflation within the specified range of 3% and 6%. However, there have been times in the past where the rate of inflation rose above the specified target range of 3% to 6%, predominantly during its initiation stage, the global financial crisis and post-recession. On average, the rate of inflation has been approximately 6% since the commencement of inflation targeting in 2000. There has been much criticism by various macroeconomists and leaders of trade unions regarding the current monetary policy approach, citing its inability to reduce the unemployment cost of fighting inflation (sacrifice ratio) as one of its major shortcomings (Vellery & Ellyne, 2011).

Despite the fact that inflation rates have been moderate since the introduction of the inflation-targeting system in 2000 as compared to the past trends, when inflation was high but relatively stable, the recent rates of inflation have been of great concern. In particular, since 2000 the annual rate of inflation has been frequently on the upper end of the targeted range of 3% to 6%. As a result, this raises concern with regard to the effectiveness of the current monetary policy approach on whether there is a shift in the determinants of inflation differing from those that were identified prior to the change in South Africa's monetary policy system in 2000.

High inflation is associated with substantial inflation volatility causing uncertainty in price level expectations thus making long-term economic decision making more difficult, particularly for the unemployed citizens that are already part of a lower income group. Thus, inflation, whether anticipated or unanticipated, has numerous implications in the economy, even at moderate rates. In order to determine this, there is a need to understand its determinants if stability is to be achieved. Table 1 compares South Africa's inflation with three of its five most important trading partners, based on bilateral manufacturing trade data for the period 1970 to 2013.

TABLE 1: **Annual average inflation rate for South Africa and its major trading partners**

Period	RSA	USA	UK	CHINA*
1970–1979	9.89%	7.10%	12.65%	–
1980–1989	14.68%	5.55%	7.11%	12.70 %
1990–1999	8.99%	3.00%	3.31%	7.75%
2000–2013	5.88%	2.43%	2.26%	2.32%

Source: Authors' calculations from IMF (2015); World Bank (2015); Stats SA (2015)

* *Note that the average annual inflation rate for China only include data from 1986–2013.*

Table 1 shows that the inflation rate between South Africa and USA in the 1970s averaged 9.89% and 7.10% respectively. The difference between the two countries' inflation rates at the time was relatively small at 2.79%. However, during the 1980s the average inflation rate in the USA declined from 7.10% in the 1970s to 5.55%, while in South Africa inflation increased from 9.89% to 14.68%. According to Ricci (2005), South Africa's major trading partners experienced a steady decline in inflation over the past two decades, which was reflected by lower imported inflation in South Africa resulting from an increasing openness of the economy in the early 1990s. According to De Waal and Van Eyden (2012), South Africa's trade with the UK, USA, Japan and the Euro area has been decreasing over the past few decades. Cawker and Whiteford (1993) found that high rates of inflation in the past have led to reduced South Africa's competitiveness in relation to its trading partners and competitors.

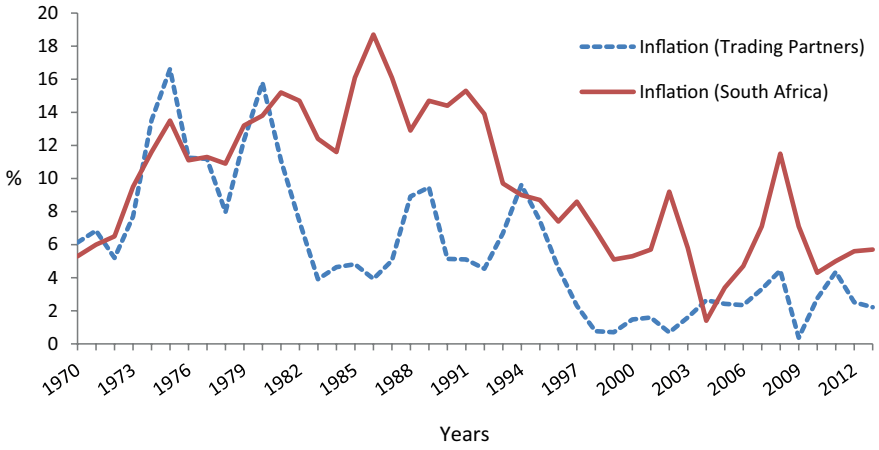

FIGURE 1: **Inflation trends between South Africa and its main trading partners***

Source: IMF (2015); Stats SA (2015)

* Inflation for the trading partners was calculated as an average for USA, UK and China. However, it should be noted that inflation rates for China only include the period from 1986-2013.

The 1980s was a period of high double-digit inflation in South Africa as indicated by an average inflation rate of 14.68%, which was attributed to monetary policy during Gerhard de Kock's tenure as Governor of the Reserve Bank between 1981 and 1989 (Fourie & Burger, 2009; Mohr &67 Fourie, 2008). When compared to inflation figures of major trading partners, South Africa experienced relatively high levels of inflation, more than double when compared with those of the USA and UK for the period 1982 to 1987. Figure 1 shows the trends of inflation for South Africa and its trading partners.

As shown in Figure 1, inflation in South Africa followed a similar pattern (upward trend) to that of its major trading partners for the period from 1970 till the late 1980s, in particular the USA and UK. The movement of inflation is roughly comparable in terms of a business cycles pattern. A declining trend in inflation since the 1970s is common among the countries.

During the 1980s, the average inflation rate for South Africa's major trading partners declined significantly from 15.79% in 1980 to 3.9% in 1983. This decline recorded the lowest inflation rate since the period of high global inflation which was experienced in the 1970s, particularly for the USA and UK. Since 1983, the average inflation for the major trading partners has been increasing steadily, with the highest rate being 9.5% in 1984, and has been relatively stable with a figure just below 5% since 1996. On the other hand, inflation in South Africa was relatively high in 1986, recording a historic rate of 18.7%, while the USA and UK recorded 13% and 18% respectively in 1980. The rate of inflation had been relatively high but stable, and the trend had been decreasing, albeit at high rates when compared to countries such as the USA, UK and China.

Inflation in South Africa remained relatively high between 1980 and 2000 even though there was a steady decline in the rate of inflation for its major trading partners. It is believed that the weaker monetary stance taken during that period was the main reason why inflation remained high, while major trading partners were experiencing disinflation (Fourie & Burger, 2009). The robust or more aggressive monetary policy stance (i.e., high interest rate) that was taken in the early 1990s (an eclectic monetary policy framework) has contributed to a significant decline in the inflation differential between South Africa and its trading partners.

The introduction of inflation targeting saw South Africa's level of inflation declining to an average of 5.55% between 2000 and 2013. Although the financial crisis had a severe effect on domestic and global inflation between 2008 and 2009, South Africa's average level of inflation followed a more or less similar trend to that of its major trading partners.

The evolution of the South African monetary policy since the 1970s signals the importance of examining the causes of inflation to align them with changing economic conditions; as such, this study seeks to bridge the literature gap by identifying alternative factors that cause inflation in South Africa different from the factors that have been investigated in previous studies. This study also takes into account the impact of the inflation-targeting framework and its effect on the level of inflation in South Africa

since its introduction. It intends to investigate the determinants of inflation with the aim of evaluating the effectiveness of anti-inflationary policy and providing recommendations based on the results obtained from the model, so that the recommendations would assist policy makers in achieving the desired long-run inflation target of between 3% and 6% in South Africa.

3. Literature Review: An overview

The determinants of inflation remain an important macroeconomic issue for policy makers. Inflation is one of the key macroeconomic variables and is closely monitored both by policy makers and society as they are directly affected by its outcomes. Inflation is determined by various domestic and external factors. Although various studies have been conducted over the years, they have come to different (but often similar) conclusions. The importance of identifying the causes of inflation in pursuit of an effective anti-inflationary policy that is aimed at achieving price stability is widely acknowledged, both in theory and in practice. As such, this section considers theoretical literature on the determinants of inflation.

For the purpose of this study, theory on the determinants of inflation is explained based on several theoretical considerations. The determinants are explained with reference to two broader schools of thought on economic theory and policy. These two main schools of thought can be found within mainstream economics, namely Keynesian and monetarist, or the new classical school of thought. In an effort to explore other views regarding the causes of inflation, structuralist theory will also be explored to capture the extent to which structural factors influence inflation.

It is strongly suggested by Friedman (1968) that inflation is and will always be a monetary phenomenon. The monetarist or rather new classical economists suggest that an increase in money supply has always been identified as one of the major, if not common, determinants of inflation. As indicated by Mankiw (2012, p. 348), this theory is often referred to as "classical" because it was developed by some of the earliest economic thinkers. In explaining the classical theory of inflation, a distinction should be made with regard to the interpretation of how growth in money supply affects economic variables, particularly prices. Friedman (1968) and Mankiw (2012) discussed classical economist views of separating variables into two groups, namely nominal and real variables (the concept that is also known as classical dichotomy). The proposition is that money supply does not have any effect on real variables (also known as monetary neutrality).

Arnold (2008) further indicated that the classical economist position with monetary growth as a determinant of inflation was based on the theory of exchange rates and simple quantitative theory of money. According to the quantity theory of money, the long-run effect of money is only on the average price level, and the price level cannot increase without an increase in money supply (Fourie & Burger, 2009). According to

Abel et al. (2008, p.270), for countries with a higher rate of inflation, growth in nominal money supply is regarded as the most important factor in the inflationary process.

While monetarists hold that inflation is purely a monetary phenomenon that can prevail only as a result of expansion in money supply at a rate that is faster than growth in output capacity, the Keynesian theory of inflation holds a different view of what constitutes inflation. According to Humphrey (1975), monetarists reject non-monetary explanations of inflation proposed by the Keynesian theory, which include, among others, shifts in Government fiscal policies, cost push factors, food and fuel shortages, on the basis that inflation can only occur as a result of excessive growth in money supply.

While the monetarist takes into consideration the classical dichotomy, the Keynesian view makes a distinction between demand inflation and cost inflation. According to Mohr and Fourie (2008), demand pull inflation occurs when the aggregate demand for goods and services increases while the aggregate supply remains constant or unchanged. The demand pull theory suggests that inflation occurs as a direct or indirect effect of both expansionary monetary and fiscal policy. According to the demand pull theory, the excess demand pressure pulls up the prices of goods and services, resulting in an increase in the general price levels (Dhakal et al., 1994; Mohr & Fourie, 2008). Contrary to the demand pull theory, the cost push theory states that prices increase as a result of factor prices that accelerate more than factor productivity. The cost push theory suggests that inflation occurs as a result of decrease in aggregate supply (Dhakal et al., 1994; Mohr & Fourie, 2008). According to Whyte's (2011) observations, in developed countries inflation is caused by changes in the cost of labour and labour market rigidities, albeit considered to be not the main determinants of inflation in most developing countries.

Elsewhere, structuralists distinguish between basic (or structural) inflationary pressure and mechanisms that transmit or propagate such inflationary pressure in the economy (Akinboade et al., 2004). The structuralist theory on inflation is based on the approach developed in Latin America by Prebisch (1961) and others. This theory is still widely used, primarily as a diagnostic and policy tool for inflation.

The structuralist model developed by Cardoso (1981) is regarded as one of the best models of structural inflation (Akinboade et al., 2004). The model showed that increase in manufacturing costs led not only to higher prices, but also to an inflationary process that tends to be self-perpetuating. Furthermore, the model also revealed that the structuralist interpretation allowed for a better understanding of the inflationary process in Latin America and provided an insight on the options available to the Government in dealing with this inflationary process (Cardoso, 1981).

One of the most important arguments by the structuralist school is that the roots of inflation can be found in bottlenecks of "inelastic supply" in the agricultural sector (Prebisch, 1961; Cardoso, 1981). Agenor and Montiel (1996) maintain that this inelastic supply in the agricultural sector (i.e., inelastic supply of foodstuffs) is one of the key structural bottlenecks identified by the structuralist theory, which include, among

others, the foreign exchange constraint, distorting government policies, the conflicts between capitalists and workers over income distribution between profits and real wages. However, Mohr (2008) states that the most important aspect of this (structural) approach is that it focuses primarily on the fact that inflation is a process.

The structuralist approach retains the distinction between demand pull and cost push approach. However, they place it in a much broader context (Mohr & Fourie, 2008; Mohr, 2008). Ackley (1959) argued that the distinction between demand and cost inflation did not provide sufficient support toward understanding the inflationary process in modern capitalism, particularly during the period of stagflation in the 1950s.

In an effort to provide a broader explanation on the causes of inflation, the structuralist approach identifies the underlying factors – which include, among others, a variety of non-economic dimensions, i.e., political, social and historical factors – in the determination of inflation (Fourie et al., 2009). This is similar to Dagum's (1969) views on inflation. According to Dagum (1969), inflation is a process originating from economic, political and social causes. Structuralists do not agree with the monetarist belief that inflation is apurely monetary phenomenon.

According to the structuralist views, growth in money supply is indicative of the existence of upward pressure exerted on price by changes in structural and cost factors (Canavese, 1982). Mohr's (2008) analysis on the three fundamental structural causes of inflation states that the underlying factors provide that the basis against which the inflation process occurs defines the vulnerability of the economy to inflation. Similarly, Wachter (1979) suggests that "Structural problems are considered to be at the root of inflation, however, demand problems are clearly related to the propagation arid persistence of the phenomenon." This implies that although the underlying factors cannot provide a clear explanation of why the rate of inflation is what it is or the reason why it sometimes falls or accelerates, they still remain important factors in the determination of inflation.

Other theories that explain the inflation phenomenon include purchasing power parity, which states that any commodity in a unified market has a single price. According to this theory, changes in the domestic price are influenced by the volatility of the exchange rate as a result of inflation differentials between two countries (Akinboade et al., 2004).

On the empirical front, the De Kock Commission (1985) investigated the determinants of inflation and found, among other factors, that the tax increase, imported inflation and increase in wage and salaries in excess of productivity were insignificant in influencing the rate of inflation in South Africa. These findings were criticised by Mohr (1986) on the basis that the methodology and model applied in the study were not sufficiently robust to estimate the determinants of inflation.

Moore and Smit (1986) also criticised the Commission's findings providing evidence that wage prices had a significant influence on inflation in South Africa. These findings also correspond with the views of Pretorius and Smal (1994) that the increase in labour cost

that is compelled by inflation expectations influences the rate of inflation. Mohr (1986) further argues that the bias of the De Kock Commission towards monetarist views on the causes of inflation might have led to the conclusion that salaries and wages, imported inflation and tax increases were insignificant in influencing inflation in South Africa.

De Waal and Van Eyden (2012) applied a vector error correction model (VECM) analysis to monetary inflation and inflation in South Africa and found that deviations from the purchasing power parity (PPP) explain inflation and the real effective exchange rates. On the contrary, Mohr (2008) suggested that although import prices can rise, inflation cannot be imported except under special circumstances, such as in West Germany during the 1950s and 1960s (Mohr, 2008). However, Atta et al. (1999) and Goamab (1998) do not share the same view as Mohr (2008). They indicated that inflation in Botswana and Namibia was influenced by South African prices through exports, suggesting that indeed imported inflation does exist. In the South African experience, Pretorius and Smal (1994) also had a contradictory view to Mohr (2008), stating that the cost of imported goods also contributed to inflation.

Fedderke and Schaling (2000) used multivariate co-integration techniques to examine the cause of inflation in South Africa by analysing the link between unit labour cost, real exchange rate, output gap, inflation expectations and actual inflation prior to the introduction of the inflation-targeting framework in 2002. The results of the analysis of quarterly data for the period 1963Q4 to1998Q2 confirmed the findings of earlier studies such as by Pretorius and Smal (1994), revealing that inflation was influenced by the marked-up behaviour of unit prices over labour cost. Their result was consistent with the cost push view on the inflationary process in South Africa.

Kaseeram et al. (2004) estimated the relationship between inflation and excess demand, labour costs, import prices, exchange rates and short-run interest rates for the period from 1978Q1 to 2000Q4 using the vector auto-regression (VAR) approach and VECM. The study found that nominal exchange rates, nominal effective exchange rates and the import price index had a significant influence on the price level (Kaseeram et al., 2004). Akinboade et al. (2004) applied VAR and VECM techniques to determine the long-run and short-run relationship between inflation and its determinants for the period 1970Q1 to 2000Q2. The study found evidence of a stable relationship between domestic prices, money supply, nominal exchange rate and import prices.

Earlier studies, such as that by Moser (1994), applied the error correction model (ECM) to determine the causes of inflation in Nigeria. The study found that both fiscal and monetary factors had a major influence on the impact of the depreciation of the Nigerian currency on inflation. Lim and Papi (1997) also used an ECM model which included both long-run and short-run dynamics to examine the determinants of inflation in Turkey from 1970 to 1995. The study found that monetary factors (i.e., exchange rate, money supply) played a significant role in the process of inflation in Turkey, while the public sector deficit was also found to have had a significant direct influence on the rate of inflation.

AlexovÃi (2012) conducted a study on the determinants of inflation for new European Union (EU) members for the period 1996 to 2011. This study found that both cost push and demand pull factors affected inflation in the long run, while short-run dynamics of inflation were explained by price expectations, labour cost and other exogenous shocks among other factors.

Empirical evidence from developing and developed countries revealed that different factors explain the dynamics of inflation, and by applying various econometric techniques, empirical evidence showed varied and often inconclusive results. Despite the inconclusiveness of the results, growth in money supply, labour cost, fiscal expenditure, exchange rate and import prices have been found to be the most common determinants of inflation in the reviewed studies.

4. Methodology

4.1. The empirical model

The model used in this study partly draws from the studies of Moser (1994) and Kuijs (1998) and incorporates elements of Greenidge and Da Costa (2009), Khathlan (2011) and Adu and Marbuah (2011) on the determinants of inflation. Given the time that some of these studies were conducted and the structural and monetary developments that have taken place during the past twenty five years, a revisit of the topic using improved econometric techniques and recent data to get a renewed overview on the determinants of inflation in South Africa cannot be overemphasised. The modified model is expressed as follows:

$$INF = f(INF_{t-1}, EXR, FGCE, GDP, IM, LW, M2) \quad (1)$$

The study estimates the following model:

$$logINF_t = \propto_0 + \beta_1 logINF_{t-1} + \beta_2 logEXR_t + \beta_3 logFGCE_t + \beta_4 logGDP_t + \\ + \beta_5 logIM_t + \beta_6 logLW_t + \beta_7 logM2_t + \beta_8 DUM00 + \mu_t \quad (2)$$

where *INF* is inflation, INF_{t-1} represents inflation expectation, EXR_t is real effective exchange rate, $FGCE_t$ is final government consumption expenditure, GDP_t is real *GDP*, IM_t represents import prices, LW_t is nominal unit labour cost, $M2_t$ is money supply and *Dum00* is a dummy variable whose value is equal to 1 during the period 2000Q1 – 2015Q4 and 0 otherwise, capturing the change in monetary policy framework from eclectic approach to inflation targeting in 2000. $\propto$ is the constant, β is the respective coefficients, *t* is time period, and μ_t is the well- behaved error term.

Considering that inflation expectations play an important role in the current monetary policy conduct in South Africa (see Kaseeram et al., 2004; Mohr & Fourie, 2008;

Fourie & Burger 2009), the study estimates the influence of inflation expectations in South Africa. While there are various models for inflation expectations, this study follows the Moser (1994) model, where the expected rate of inflation in period t is assumed to be based on adaptive expectations. According to the adaptive expectations theory, the current inflation rate is used as an indicator of the next period's inflation rate (Moser, 1994; Kaseeram et al., 2004). Thus, the equation for expected inflation is expressed as follows:

$$E(\pi_t) = d_1(\Delta logInf_{t-1}) + (1 - d_1)\pi_{t-1} \quad (2.1)$$

where $\Delta logINF_{t-1}$ and $\pi_{t-1} = 1$ represents actual inflation and expected inflation respectively in period $t - 1$. For the purpose of this study, it is assumed that $d_1 = 1$, the inflation expectation equation, can be specified in a reduced form model as follows:

$$E(\pi_t) = \Delta logINF_{t-1} \quad (2.2)$$

Inflation expectations have been included in the model because the price formation process in South Africa is dependent on changes in labour costs, which are mainly driven by expectations. Based on the results of previous empirical studies, the coefficient of inflation expectations is expected to have a positive influence on current inflation.

Other determinants of inflation employed in the model include exchange rate, government consumption expenditure, economic growth, import prices, labour cost and money supply.

Exchange rate is included in the model as an independent variable since evidence from previous empirical studies revealed that domestic prices are influenced by the volatility in the exchange rate. Based on empirical studies the coefficient of exchange rate is expected to be negative and statistically significant.

The role of government expenditure on inflation is well supported both in theoretical and empirical literature. The impact of government consumption expenditure is supported by the Keynesian demand pull inflation theory, which suggests that excessive demand pressure pulls up the prices of goods and services, which eventually results in an increase in the general price level. In this study, the coefficient of government expenditure is expected to be positive and statistically significant.

Economic growth has been found to be one of the key determinants of inflation. According to Odhiambo (2012), "the dynamic relationship between inflation and economic growth has recently been a subject of intense debate," and it remains a controversial issue on both the theoretical and the empirical fronts. In other words, the expected relationship between economic growth and inflation could be negative, positive or neutral. In this study, the coefficient of economic growth is expected to be negative and statistically significant.

Import prices are included in the model as a measure of the cost of goods and services bought by local residents from a foreign country which could include either fi-

nal products destined for final consumption or intermediate products that are further processed or manufactured into final consumable products. The coefficient of import prices is expected to be positive and statistically significant.

Labour cost has been found to be another key determinant of inflation. Economic theory suggests that if increases in labour costs exceed productivity gains, it results in an upward pressure on prices, thereby resulting in an increase in the general price level. In this study, the coefficient of labour cost is expected to be positive and statistically significant.

Money supply has been found crucial in determining the level of inflation not necessarily because of its direct impact on prices but because variation in money growth constitutes most of the variations in growth in aggregate demand. Based on the previous empirical studies, the coefficient of money supply in this study is expected to be positive and statistically significant.

4.2. ECM estimation techniques

The study employs an Error Correction Model (ECM) that was first used by Sargan and later popularised by Engle and Granger (Gujarati & Porter 2009, p. 764). The ECM approach incorporates both the long-run and short-run effects simultaneously and provides the speed of adjustment coefficient that measures the speed at which inflation reverts to its long-run equilibrium position following a shock in the system. This study followed a cointegration technique proposed by Johansen (1988) and Johansen and Juselius (1990).

The Johansen-Juselius cointegration technique was applied to examine whether the variables are cointegrated. However, one of the limitations of the test is that it relies on asymptotic properties and is therefore sensitive to specification errors in limited samples. The ECM was applied in order to capture short-run disequilibrium between inflation and its determinants. According to Brooks and Tsolacos (1999), an ECM technique has proven to be effective in capturing the short-run and long-run relations between dependent and explanatory variables.

The order of integration of a time series is of great importance in econometric analysis, and several statistical tests have been developed to examine its existence (Lütkepohl & Krätzig, 2004, p. 13). Prior to applying the Johansen-Juselius cointegration technique, the first step is to determine if the variables are integrated of the same order. In determining the integration properties of the data, the study applies the Dickey-Fuller Generalised Least Square (DF-GLS) and Philips Perron (PP) unit root test to check for data stationarity. If a series is stationary without any differencing, it is integrated of order $I(0)$, while a series that is stationary at first differences is integrated of order $I(1)$.

The study followed the general-to-specific approach, which involves the inclusion of many variables and complex lag structures. The model will then be reduced to a parsimonious form following the general-to-specific approach to the preferred model spec-

ification. The characteristics and behaviour of the general model and the parsimonious models will be examined and the model stability tests will also be performed.

In order to derive a model that is deemed appropriate for evaluating the determinants of inflation in South Africa, the model specification in Equations 1 and 2 has been extended and modified to represent an ECM as follows:

$$\Delta logINF_t = \propto_0 + \beta_1 \Delta logINF_{t-1} + \beta_2 \Delta logEXR_t + \beta_3 \Delta logFGCE_t + \beta_4 \Delta logGDP_t + \beta_5 \Delta logIM_t + \beta_6 \Delta logLW_t + \beta_7 \Delta logM2_t + \beta_8 DUM00 + \gamma ECM_{t-1} + \mu_t \quad (3)$$

Where ECM_{t-1} is the lagged value of the error correction term, rate and Δ represents first differences. The size of the coefficient γ indicates the speed of adjustment towards equilibrium and the rest of the variables are as described in Equation 2.

4.3. Data source

The study employs quarterly time series data for the period from 1970Q1 to 2015Q4. The data is sourced from the electronic database of the SARB, Stats SA, the International Monetary Fund (IMF) and the World Bank. The variables included in the study consist of nominal effective exchange rate (EXR), final government consumption expenditure (FGCE), real GDP, import prices (IM), nominal unit labour cost (LW) and money supply (M2) as the determinants of inflation (INF).

5. Empirical results

5.1. Unit root tests

Prior to making any analysis on the determinants of inflation in South Africa, variables are first tested for stationarity using Dickey-Fuller generalised least square (DF-GLS) and Phillips-Perron (PP) unit root tests. The results of the unit root tests are reported in Table 2.

TABLE 2: **Unit root tests of all variables**

Stationarity of all Variables				
Dickey-Fuller generalised least square (DF-GLS)				
Variable	Stationarity of all Variables in Levels		Stationarity of all variables in First Difference	
	Without Trend	With Trend	Without Trend	With trend
lnINF	0.147	-0.608	-2.155**	-2.667*
lnEXR	1.651	-2.509	-5.691***	-5.785***
lnFGCE	1.576	0.104	-1.783*	-4.302***
lnGDP	2.724	-1.453	-3.666***	-5.491***
lnIM	4.424	-2.574	-11.197***	-12.648***
lnLW	2.144	-0.818	-3.498***	-4.632***
lnM2	0.919	-0.369	-2.866***	-8.817***

Phillips-Perron (PP)				
Variable	Stationarity of all Variables in Levels		Stationarity of all variables in First Difference	
	Without Trend	With Trend	Without Trend	With trend
lnINF	-2.546	0.682	-7.155***	-8.074***
lnEXR	-0.401	-2.206	-11.700***	-11.668***
lnFGCE	-1.249	-0.005	-15.124***	-16.378***
lnGDP	-0.394	-1.666	-10.524***	-10.497***
lnIM	-1.113	-3.409	-12.927***	-12.944***
lnLW	-1.665	-1.001	-16.759***	-16.995***
lnM2	-1.851	0.024	-9.573***	-9.613***

*Note: *, ** and *** denote stationarity at 10%, 5% and 1% significance levels respectively.*

Overall, the stationarity results presented in Table 2 indicate that all variables are conclusively non-stationary in levels. However, after being differenced once, all variables became conclusively stationary. After establishing that all the variables are of the same order of integration [I(1)], the procedure for testing for the possibility of cointegration among the variables is applied using the Johansen cointegration approach to check if there is an existing long-run relationship between variables under study.

5.2. Cointegration test results

In applying the Johansen-Juselius cointegration, it is important to determine the optimal lag length (k). In this instance, Akaike Information Criterion (AIC) and Schwarz Information Criterion (SC) tests were applied in order to guide the choice of the lag length.

The study proceeds to Johansen-Juselius cointegration analysis to check if there is an existing long run relationship between inflation and its determinants. The Johansen-Juselius cointegration tests the null hypothesis of no cointegration against the alternative that there is an existing cointegrating vector. The null hypothesis is rejected when the trace and max statistics are greater than the critical values. The results of the Johansen-Juselius cointegration test are presented in Table 3 for both the maximum eigenvalue statistic and the trace statistic respectively, allowing for unrestricted intercepts and no trends.

Based on the results presented in Table 3 Panel A, the null hypothesis of no cointegration was rejected based on the trace statistic which was greater than the critical value. In other words, there is very strong evidence that the variables included in the systems are cointegrated. Thus the trace statistic tests strongly confirm the existence of one cointegrating equation.

Table 3 Panel B shows that the null hypothesis of no cointegration was rejected based on the maximum eigenvalue, which was found to be greater than the critical value. This result suggests that one cointegrating equation exists in the model.

TABLE 3: **Results of cointegration test**

Panel A: Trace test				
H0: Rank=P	**Hypothesized No. of CE(s)**	**Trace Statistic**	**0.05 Critical Value**	**Probability****
p=0	None *	135.97	125.62	0.010
P≤1	At most 1	89.09	95.75	0.132
P≤2	At most 2	57.83	69.82	0.308
P≤3	At most 3	39.29	47.86	0.249
P≤4	At most 4	23.73	29.80	0.212
P≤5	At most 5	12.30	15.49	0.143
P≤6	At most 6	1.35	3.84	0.244
Panel B: Maximum eigenvalue test				
H0: Rank=P	**Hypothesized No. of CE(s)**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Probability****
p=0	None *	46.88	46.23	0.043
P≤1	At most 1	31.26	40.08	0.345
P≤2	At most 2	18.54	33.88	0.849
P≤3	At most 3	15.56	27.58	0.703
P≤4	At most 4	11.43	21.13	0.604
P≤5	At most 5	10.94	14.26	0.157
P≤6	At most 6	1.35	3.84	0.244

** denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values*

The result of the maximum eigenvalue statistic is in line with the results obtained from the trace test statistics, which also indicated that one cointegrating equation exists in the system. Based on the results presented in Table 3, the Johansen-Juselius cointegration test indicates the existence of a long-run relationship between inflation and its determinants. Having established that the variables are cointegrated, the study proceeds to estimate an error correction model.

5.2. Estimated error correction model

Subsequent to examining cointegration analysis, the evidence from the Johansen-Juselius procedure suggests the existence of cointegration among variables. The Johansen-Juselius cointegration test revealed that inflation and its determinants are cointegrated, and this formed a basis for estimating the ECM model. Using the general-to-specific modelling techniques to arrive at a parsimonious model, the ECM results are presented in Table 4.

The results reported in Table 4 indicate that there is a positive and significant relationship between inflation and lagged inflation in South Africa. The lagged coefficient of inflation is positive and statistically significant at 1% significance level, suggesting that an increase in the previous quarter inflation results in an increase in the current inflation rate. This result confirms the influence of inflationary expectations in the South

TABLE 4: **Empirical results of the error correction model**

Dependent Variable: *lnINF*			
Variable	**Coefficient**	**t-Statistic**	**Probability**
$lnINF_{t-1}$	0.32***	4.80	0.000
$\Delta lnEXR_t$	0.01	0.41	0.679
$\Delta lnEXR_{t-2}$	-0.02*	-1.83	0.070
$\Delta lnFGCE_t$	0.04*	1.88	0.062
$\Delta lnGDP_t$	-0.31***	-3.84	0.000
$\Delta lnEIM_t$	0.03***	2.89	0.004
$\Delta lnIM_{t-1}$	0.03***	2.98	0.003
$\Delta lnLW_t$	0.05***	2.74	0.007
$\Delta lnLW_{t-1}$	0.04**	2.00	0.047
ΔlnM_t	0.03	1.06	0.289
$DUM0_0$	-0.01***	-4.27	0.000
ECM_{t-1}	-0.07**	-2.60	0.010
c	0.01***	5.72	0.000
R^2	0.56	F-statistic	17.50
Adjusted R^2	0.52	Prob (F-statistic)	0.00***
S.E. of regression	0.01	Durbin-Watson stat	2.00

*Note: *, ** and *** denotes 10%, 5% and 1% significance levels respectively.*

African economy. This finding is in line with the findings of Kaseeram et al. (2004), Akinboade (2004), Adu and Marbuah (2011) and AlexovÃi (2012).

There is a negative relationship between the inflation and exchange rate (as proxied by NEER index) in South Africa. The lagged coefficient of the exchange rate is negative and statistically significant at the 10% significance level. Since an increase in NEER, a proxy for the exchange rate, indicates an appreciation of the local currency against the weighted basket of currencies of its trading partners, this result implies that depreciation/appreciation in the exchange rate for the previous quarters would result in an increase/decrease in the current rate of inflation. The negative lagged coefficient of the exchange rate reported in Table 3 suggests that depreciation of the Rand may have adverse effects on domestic inflation.

The coefficient of government consumption expenditure is positive and statistically significant at the 10% significance level. This result suggests that an increase in the Government consumption expenditure leads to an increase in domestic inflation. A positive and significant coefficient confirms the existence of demand-pull inflation in South Africa. This finding is similar to some empirical studies that found a positive relationship between government consumption expenditure and inflation (see, among others, Moser, 1994; Anoruo, 2003; Adu & Marbuah, 2011). GDP has negative and significant influence on domestic inflation. This implies that an increase in the GDP results in a decrease in the rate of inflation. This result supports empirical findings such as

those of Barro (1996), Fischer (1993) and De Gregorio (1993), who found evidence of a negative relationship between GDP and Inflation.

The relationship between import prices and inflation is positive and statistically significant. The result suggests that a 1% increase in import prices results in an increase in inflation. Similarly, the lagged coefficient of import price also suggests that an increase in the previous period import price results in an increase in the current quarter's inflation. The coefficients of import prices are statistically significant at the 1% significance level respectively. For an import-dependent country such as South Africa, it is evident that external cost push factors have had a significant impact in determining domestic prices in South Africa.

While Mohr (2008) argues that although import prices can rise, inflation (a process) cannot be imported, except under special circumstances; empirical results obtained in this study are consistent with economic theory as postulated by structuralist cost push factors. The results are also in line with other empirical studies such as those by Lim and Papi (1997), Kaseeram et al. (2004), Monfort and Peña (2008) and Ziramba (2008), who also found the existence of positive import price pass-through to domestic inflation in South Africa.

Unit labour cost is positively and significantly associated with inflation in South Africa. This result suggests that an increase in unit labour cost leads to an increase in the rate of inflation. The lagged coefficient of unit labour cost is also positive and statistically significant, suggesting that an increase in unit labour cost during the previous quarter results in an increase in domestic inflation for the current quarter. The coefficients of unit labour cost are also found to be statistically significant at the 1% and 5% significance level respectively. These results are in line with economic theory and findings of other empirical studies, such as Kaseeram et al. (2004) and Lim and Papi (1997), that an increase in labour costs results in an increase in the rate of inflation. The result obtained further emphasizes the role and impact of labour cost in the inflationary process between 1970 and 2015 and also reveals that cost push factors are significant determinants of inflation in South Africa.

Money supply was found to be statistically insignificant in terms of its influence on the rate of inflation in South Africa.

The dummy variable is negatively related to the domestic inflation and its coefficient is statistically significant at the 1% significance level. The inclusion of the dummy also enhanced the stability of the model, capturing structural effects of the introduction of inflation targeting framework in 2000. The negative and highly significant coefficient implies that the current monetary policy framework had contributed to the reduction in inflation since its inception. This also suggests that although there has been mixed success in the past, the current monetary policy framework remains relevant and effective in keeping inflation within the desired target range of 3% to 6%.

The error correction coefficient is negative and statistically significant, as expected. This result also confirms the presence of a long-run level equilibrium relationship

between inflation and its identified determinants. Deviations in inflation adjust by approximately 7% quarterly to re-establish its long-run equilibrium path.

In terms of the overall stability of the model, diagnostic tests were performed to formally check the model assumptions and properties. The Breusch-Godfrey Serial Correlation LM test showed that the residuals in the model are not serial-correlated, there is no heteroscedasticity in the error variance, and the Jarque–Bera (JB) test revealed that the residuals are normality distributed. The Ramsey Reset test confirmed that the error correction model has no specification error. Based on the diagnostic test results, it was therefore concluded that the estimated ECM model is correctly specified and the parameter estimates are valid and unbiased.

6. Conclusions and policy implications

This study investigated the determinants of inflation in South Africa for the period from 1970Q1 to 2015Q4. The overall empirical findings of the study revealed that domestic inflation is determined by both internal and external factors. The results from the study revealed that internal factors such as inflation expectations, government consumption expenditure, GDP, unit labour cost, and external factors, such as import price (foreign prices) and exchange rate, were significant determinants of inflation in South Africa for the period from 1970Q1 to 2015Q4.

The results of this study also revealed that external factors are significant in determining domestic inflation, particularly given South Africa's degree of reliance on imports. The continued depreciation of the rand could further exacerbate the impact of imported inflation. While cost push factors were found to be dominant in determining domestic inflation in the model, demand pull inflation factors were also found to be significant determinants of inflation in South Africa.

Stable and low inflation in the interest of maintaining balanced and sustainable economic growth is among the main macroeconomic policy objectives in South Africa. While the formulation and pursuit of this policy objective is not an easy task, sustainable economic growth remains crucial in determining the level of domestic inflation. In order to achieve the objective of stable and low inflation there is a need to explore other sustainable growth stimulation policies since the results of this study suggest that potential growth prospects have significant policy implications on domestic inflation. Based on the results of the study and taking into account the lesser degree of control that monetary authorities have in influencing labour costs, which is also significant in influencing inflation in South Africa, it is recommended that more emphasis be placed on anchoring inflation expectations. This recommendation emanates from the fact that inflation expectations play an important role in influencing labour costs (i.e., through price-wage inflationary spiral) and subsequently the rate of inflation under the current monetary policy framework (see SARB, 1994; Kaseeram et al., 2004).

The study further recommends that a more comprehensive set of fiscal and industrial policy instruments (which include, among others, producer support through subsidisation and reduction of import tariffs on input material not available domestically) be considered. This consideration should be based on using non-monetary support mechanisms (such as increase in import duties to protect domestic industries) that do not result in an increase in government expenditure. Other cost-saving and industrial policy programmes (such as Special Economic Zones) that are designed to improve efficiency and reduce the cost of production should also be prioritised.

Finally, the result of the study also shows that although the current monetary policy framework has had mixed success since its implementation, where inflation has moved above the 3% to 6% target or has been consistently at the upper band of the target, monetary authorities have in most instances been able to maintain the rate of inflation within the set target. It is also important to note the overall positive contribution of an inflation-targeting framework in South Africa since its implementation. Thus, it is recommended that inflation targeting as a monetary policy framework in South Africa be maintained while simultaneously being supplemented by other non-monetary policy measures in order to achieve the macroeconomic policy objective of stable and low inflation in South Africa.

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